

# Geometry

## I. Geometric Structure

### A. Axiomatic Systems

1. Develop an awareness of the structure of a mathematical system, connecting definitions, postulates, logical reasoning, and theorems.
2. Recognize that the study of geometry was developed for a variety of purposes and that it has historical significance.

### B. Verification of Conjectures

1. Explore attributes of geometric figures using constructions with straight-edge and compass; paper folding; and dynamic, interactive geometry software.
2. Make and verify conjectures about angles, lines, polygons, circles, and three-dimensional figures, choosing from a variety of approaches such as coordinate, transformational, or axiomatic.

### C. Logical Reasoning and Proof

1. Determine whether the converse of a conditional statement is true or false.
2. Use logical reasoning to draw conclusions about geometric figures from given assumptions.
3. Construct and judge validity of a logical argument consisting of a set of premises and a conclusion.
4. Use inductive reasoning to formulate a conjecture.
5. Use deductive reasoning to prove a statement.

### D. Representing Geometric Relationships

1. Select an appropriate representation (concrete, pictorial, graphical, verbal, or symbolic) to solve a problem.
2. Use dynamic, interactive geometry software to represent geometric relationships and solve problems.
3. Find optimal solutions to problems involving paths, networks, or relationships among a finite number of objects using digraphs or vertex-edge graphs.

## II. Geometric Patterns

### A. Two- and Three-Dimensional Geometric Figures

1. Use numeric and geometric patterns to make generalizations about geometric properties, including properties of polygons, ratios in similar figures and solids, triangle inequality, and angle relationships in polygons and circles.
2. Identify and apply patterns from right triangles to solve problems.
3. Draw, examine, and classify cross sections of three-dimensional objects.
4. Construct a three-dimensional object using a two-dimensional diagram such as a blueprint or pattern.
5. Use top, front, side, and corner views of three-dimensional objects to create accurate and complete representations and solve problems.

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6. Represent a three-dimensional object in two dimensions using graph or dot paper.

### III. Geometry of Location

#### A. Coordinate Geometry

1. Given geometric figures, utilize a coordinate system to identify and justify conjectures.
2. Use slopes and equations of lines to investigate geometric relationships, including parallel lines, perpendicular lines, and special segments of triangles and other polygons.
3. Develop and use formulas including distance and midpoint.
4. Given two ordered pairs, find the distance between them, locate the midpoint, and determine the slope of the line that contains them.

#### B. Transformations

1. Plot coordinates for translations and describe the vertical and horizontal transformational vector(s).
2. Translate, reflect, rotate, and dilate figures on the plane.
3. Analyze the symmetry of objects using the language of transformations.
4. Use transformations and their compositions to make connections between mathematics and applications including tessellations or fractals, in particular with graphing calculators and geometry software.

### IV. Geometry of Size

#### A. Measurement

1. Find areas of regular polygons and composite figures.
2. Find areas of sectors and arc lengths of circles using proportional reasoning.
3. Develop, extend, use, and prove the Pythagorean theorem.
4. Use formulas for surface area and volume of three-dimensional objects to solve practical problems.
5. Determine the resulting change in the area and volume of a figure when one or more dimension is changed.

#### B. Properties and Relationships

1. Based on explorations and using concrete models and geometry software, formulate and test conjectures about
  - a. properties of parallel and perpendicular lines, including two parallel lines cut by a transversal line,
  - b. properties and attributes of polygons and their component parts, and
  - c. properties and attributes of circles and the lines that intersect them.

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### V. Geometry of Shape

#### A. Similarity

1. Identify, describe, and defend similarity between shapes.
2. Using similarity and transformations, justify conjectures about geometric figures.
3. Utilize ratios to solve problems involving similar figures in a variety of ways, including the use of dynamic, interactive geometry software.
4. Solve applied problems using scale modeling.
5. Develop, apply, and justify triangle similarity relationships.
6. Explore concepts and applications of trigonometry by solving applied problems using right triangle trigonometry.
7. Using graphing calculators, spreadsheets, and dynamic, interactive geometry software, describe the effect on perimeter, area, and volume when length, width, or height of a three-dimensional solid is changed; apply this idea in solving problems.
8. Solve problems using proportion involving similar figures.

#### B. Congruence

1. Use congruence transformations to make conjectures and justify properties of geometric figures.
2. Justify and apply triangle congruence relationships.
3. Identify, describe, and defend congruence between shapes.